

Applicant: Hugh P. Craig
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66. (New) A composition according to claim 19, wherein the metal powder (b) is copper powder and the composition additionally includes an anti-oxidant copper deactivating agent.

67. (New) A composition according to claim 19, wherein the metal powder is copper powder and the composition additionally includes oxalyl bis benzylidene hydrazine as an anti-oxidant copper deactivating agent

REMARKS

Claims 1, 16, 18, 19, 30, 31, 37 and 39 have been amended and new claims 57-67 have been added. Claims 40-56 have been cancelled without prejudice. Accordingly, Claims 1-19, 21-22, 24-39 and 57-67 are pending. Applicant submits that although Claim 1-39 are listed in the Office Action as pending, Claims 20 and 23 were canceled in the preliminary amendment.

In the Office Action, Examiner Hamlin has rejected claims 1-39 under 35 U.S.C. § 102(b), alleging that it is anticipated by the disclosure of U.S. Patent No. 5,376,403 to Capote, et al. for the reasons previously stated in the prior Office Action of January 29, 2001.

In response to the Office Action, Applicants have undertaken to amend the claims, which, when considered together with remarks set forth herein, are deemed to place the case in condition for allowance.

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The present invention is a composition used to produce metal traces for printed circuit boards, wiring boards and the like. The composition and combination circuit board and composition, include a metal powder, a solder powder, a polymer or a monomer which is polymerisable to yield a polymer, such polymer being cross-linkable under the action of a chemical cross-linking agent. Furthermore, and importantly, the present invention also includes a chemical cross-linking agent for the polymer, such cross-linking agent having fluxing properties and being unreactive with the polymer in the absence of catalysis. The cross-linking agent is a polyacid, selected from carboxylated polymers, polycarboxylic acids and polymer fatty acids providing multiple reaction sites which lack chemical protection. The claimed composition is under storage conditions such that it does not possess a temperature sufficient for solvating and crosslinking to occur.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. V. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

The Examiner has rejected all of the claims under 35 U.S.C. § 102(b), contending that it is anticipated by the disclosure of U.S. Patent No. 5,376,403 to Capote, et al. In so doing, the Examiner has contended that since Capote, et al. disclose electrically conductive adhesive

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compositions and methods for their preparation which include a solder powder, a chemically protected cross-linking agent with fluxing properties and a reactive monomer or polymer, the reference discloses and clearly anticipates every claim. Applicants respectfully disagree with the Examiner's analysis, and request reconsideration of the claims and allowance based on the amendment to the claims and the analysis set forth herein.

The compositions must be compared in their storage condition. In that regard, U.S. Patent No. 5,376,403 to Capote, et al. discloses an electrically conductive adhesive composition which includes a solder powder and a chemically protected cross-linking agent which also later serves as a fluxing agent. This disclosure does not teach nor suggest the chemical composition of the present invention. Capote, et al. require as an essential feature the use of a chemically protected cross-linking agent, with fluxing properties upon heating. The Capote, et al. cross-linking agent is chemically protected to ensure that it cannot act as cross-linking agent under, for example, storage conditions. Not only is this disclosure not anticipatory of the present invention, it actually teaches away from the present invention.

In the present invention, a polymer or monomer which is polymerisable to yield a polymer can be crosslinked under the action of a chemical cross-linking agent. The cross-linking agent of the present invention is unprotected chemically – yet it is nonreactive with the polymer in the absence of the application of heat and catalysis. This is contrary to the disclosure and the teachings of the Capote, et al. reference. To that end, the cross-linking agents of the present invention are polyacid in nature and are selected from carboxylated

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polymers, carboxylic acids and polymer fatty acids which provide multiple reaction sites for cross-linking which are unprotected

The Examiner contends that the compositions "both have the same function, result and mode of activation (heat) and consequently read on one another." Applicants respectfully disagree.

Although the overall result of using the compositions is for a similar purpose, the compositions are clearly different. The difference between the compositions of the present invention and the compositions described in Capote, et al. is highlighted by the different physical and performance characteristics of the two compositions. In Capote, et al., heat is used to activate the chemically protected cross-linking agent by removing the chemical protection. Chemical protection is achieved in the Capote, et al. technology by, *inter alia*, esterification; and the removal of such protection results in the generation of alcohols. In fact significant amounts of esterifying compounds are employed by Capote, et al. to provide the requisite protection. For example, 9.9% of glycerol is used in Example 1 and 11.8% glycerol in Example 5. The minimum amount of glycerol shown in the examples is 7.3%, in Example 6.

it should be appreciated that the removal of the chemical protection requires energy, i.e., heat. Moreover, the removal of the chemical protection creates a significant amount of an unnecessary substance. For example, alcohols generated by the removal of the chemical

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protection are a substantial part of the adhesive, and their presence affects the processing and effects the performance of the product made from the Capote, et al. composition.

Furthermore, the additional heating requirements promote the formation of intermetallic compositions known to degrade the performance of electrical conductors and interconnects by both increasing the resistance to current flow and embrittling the trace. Such problems have been surmounted using the compositions of the present invention.

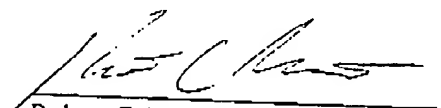
The present system is quite contrary to the Capote, et al. teaching in that there is no requirement for chemical deprotection as required by Capote, et al. The only mention of a carboxylic compound in connection with a cross-linking agent by Capote, et al. has to do with esterified carboxyl groups of relatively low molecular weight compounds which must be de-esterified during processing. As clearly described above, this leads to an inferior product which cannot be processed as simply as the claimed composition; nor does the Capote, et al. composition operate electrically as efficiently as the present invention.

In order to emphasize the distinction over carboxylic acids which have been esterified, the independent claims have been amended to clearly indicate that the reaction sites on the cross-linking agent lack chemical protection.

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In view, therefore, of the Amendment to the claims, as well as the analysis set forth above in the Remarks, it is firmly believed that the present application is in all respects in condition for allowance, which action is earnestly solicited.

Respectfully submitted,



Robert C. Morriss
Registration No: 42,910
Attorney for Applicant

HOFFMANN & BARON, LLP
6900 Jericho Turnpike
Syosset, New York 11791
(516) 822-3550
RCM:kd

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**VERSION OF AMENDMENT WITH MARKINGS
TO SHOW CHANGES MADE IN THE CLAIMS**

IN THE CLAIMS:

Please amend Claims 1, 16, 18, 19, 30, 31, 37 and 39 as follows:

1. (Twice Amended) A composition of matter comprising:
 - (a) a metal powder,
 - (b) a solder powder which melts at lower temperature than the metal powder,
 - (c) a polymer, or a monomer which is polymerisable to yield a polymer, said polymer being crosslinkable under the action of a chemical cross-linking agent,
 - (d) a cross-linking agent for said polymer, the cross-linking agent being selected from carboxylated polymers, polycarboxylic acids as such and polymer fatty acids [so as to provide] providing multiple reaction sites which lack chemical protection, the cross-linking agent having fluxing properties and being nonreactive at said sites with said polymer without the application of heat and provision of a catalyst for reaction therebetween, the cross-linking agent, [as such,] not reacting with said polymer under storage conditions, and the cross-linking agent being capable of solvating
 - (e) metallic oxide and metallic salt catalyst[s] which are formed by heating metallic components (a) and (b) and which promote a rapid cross-linking reaction between said polymer (c) and said cross-linking agent (d) when incorporated in said polymer, as a result of solvation of said catalyst by the cross-linking agent in the

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presence of heat, said composition being under storage conditions such that it does not possess a temperature sufficient for such solvating and crosslinking reaction to occur.

16. (Amended) A composition according to [any preceding] claim 1, further comprising a copper salt deactivator as a stability enhancer.

18. (Twice Amended) A composition for application to a dielectric substrate in a predetermined pattern and comprising, in admixture:

- (i) a metallic powder component which includes (a) a solder powder and (b) a metal powder melting at a higher temperature than the solder powder;
- (ii) a polycarboxyl compound effective as a fluxing agent for the metallic powder component at a first elevated temperature and as a cross-linking agent for an epoxy resin at a higher second temperature, the polycarboxyl compound being selected from carboxylated polymers, polycarboxylic acids as such and polymer fatty acids [so as to provide] providing multiple reaction sites which lack chemical protection, and
- (iii) an epoxy resin, which composition is at a temperature below said first elevated temperature.

19. (Twice Amended) A composition comprising in admixture:

- (i) a metallic powder component which includes (a) a solder powder and
- (b) a metal powder melting at a higher temperature than the solder powder,

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(ii) a polycarboxyl compound effective as a fluxing agent for the metallic powder component at a first elevated temperature and as a cross-linking agent for an epoxy resin at a higher second temperature, the polycarboxyl compound being selected from carboxylated polymers, polycarboxylic acids as such and polymer fatty acids [so as to provide] providing multiple reaction sites which lack chemical protection, the composition being applied to a dielectric substrate to which an epoxy resin has been pre-applied, the composition thus applied being at a temperature below said first elevated temperature.

30. (Amended) A composition according to claim [29] 18, wherein the solder powder is a tin/lead alloy.

31. (Amended) A composition according to claim [29] 18, wherein metal powder (b) is copper.

37. (Amended) A composition according to claim [35] 36, wherein the chelation agent is benzotiazole.

39. (Amended) A composition according to claim [38] 18, wherein metal powder is copper powder and the composition additionally includes oxalyl bis benzylidene hydrazine as the anti-oxidant copper deactivating agent [is oxalyl bis benzylidene hydrazine].